SECRET

MONTHLY REPORT

[redacted]

25X1

PAR 224

3 April 64

SUBJECT: 3-15X Fluid Gate Enlarger

TASK/PROBLEM

1. Develop and fabricate an enlarger having continuously variable magnification from 3X to 15X for a 70mm square negative gate size. Prints sizes to range up to 40 x 40 inches on cut sheet stock.

DISCUSSION

2. Phase I was authorized in message 2095 received 2 March 1964, and design studies on the negative transport system were started.

3. The feasibility of establishing a design group to perform this design task together with those of PAR's 202, 204, and 205 is being considered since many of the subassemblies have common requirements.

PLANNED ACTIVITY

4. Mechanical design studies will continue. The specifications for the required optical designs are being prepared and should be completed for release on/or about 1 May 64.

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DESIGN OBJECTIVE

3X - 15X FLUID GATE ENLARGER

Date: 20 February 1964

DESIGN OBJECTIVE

3X - 15X FLUID GATE ENLARGER (PAR 224)

PROBLEM

We have been requested to propose development of a high-quality enlarger to make paper prints in a range of magnification to supplement the [redacted] VG-1 and our 10-20-40X Precision Enlarger. 25X1

A magnification range of 3X to 15X, continuously variable, for a 70mm square-negative gate size is suggested. Provision is required for rapid, safe handling of roll negatives with the ability to position any point on the negative roll at the optic axis. The use of specular illumination with a fluid gate (or other "exotic" system) is requested.

PROPOSAL

We propose to make design studies directed toward a high quality photo enlarger with balanced optical, mechanical and electrical design to achieve the following objectives:

1. Magnification range: 3X to 15X, continuously variable, possibly using a series of lenses with overlapping magnification ranges.

2. Negative gate area: 70mm square.

3. Print easel: 40 inches square for cut sheet print stock of various standard sizes.

4. Negative: Roll form 70mm to 9½ inches wide on MIL Standard spools of up to 500 feet capacity (7.63" flange diameter, max.).

The design studies will explore problems associated with the critical components of the instrument as outlined below.

1. Fluid Injection Negative Gate

The negative will be held between flat glass surfaces and will be immersed in a refractive index matching fluid to provide precise focus control, masking of light scratches, and flushing away of dust particles from the film and glass surfaces. We have not previously applied the technique to a gate of this size but believe it to be feasible.

2. Horizontal Optic Axis

In order to provide the 40 x 40 inches maximum print size within the field angle limitation of high-quality lenses considerable overall length (up to about 7 feet) is required. With this requirement, the operator can have convenient access to both the negative and the print stock only with a folded or a horizontal optical path. We believe the horizontal arrangement lends itself to better optical quality and simpler mechanism.

We must explore the fluid injection problem in a vertical negative gate.

3. New Projection Lens Designs

a. Black-and-White Prints

The raw specular illumination system made practicable by the fluid gate permits reasonable exposure time at high magnification with narrow spectrum band filtering. The presence of a glass element in contact with the negative also permits the use of a "field flattener" element in the projection lens design. For making prints on non-color-sensitized (Kodabromide type) print stock, we propose to develop a lens, or a family of lenses, with narrow spectrum band correction and field flattener elements to cover the gate size and magnification range required. With these limitations, we hope to provide better image quality than that available in present lens designs.

b. Color and Variable Contrast Prints

We also propose to develop a lens or a family of lenses, with full visible spectrum correction for the gate size and magnification range required.

The addition of a field flattener to such a lens design is expected to also permit "rebalancing of the compromises" with the hope of better image quality.

4. Negative Transport System

Frequently, one or two prints are required from a single selected area in a given roll of negatives. The required negative area must be quickly presented to the printing gate from numeric specification of the frame number and X-Y coordinates. It is proposed that the successful Motorized Rewind System be modified to adopt it to this instrument and to reduce its construction and servicing costs.

5. Lens Focus Control

One of the major problems in a high quality enlarger is the inability of an operator to visually set the optimum projection lens focus. For the proposed high quality variable magnification enlarger, a system for precise resetting of the precalibrated optimum focus for each magnification value must be provided. Our present opinion is that the "tensioned thread" lens focus mechanism, as used in the 10-20-40X Precision Enlarger, combined with a lead screw drive for the print easel should be considered. Consideration will be given to computing servo systems vs manual control of settings from a tabulation of magnification - easel position - lens position.

6. Illumination System

The design of the condenser lens will be considered with the objective lens design to learn if the proposed field size and desirable lens aperture sizes are compatible with available lamps. We propose to use projection-type tungsten lamps as the sources. Color filtering and heat filters will be provided in the illumination system design.

The lamphouse design will provide the mechanism for clamping the negative against the focus registration glass in the projection lens assembly and for releasing it for negative removal. The lamphouse assembly will be removable to permit gate cleaning or replacement for color printing.

7. Print Stock Easel Design

Means for rapid mounting and removal of cut sheet print stock in a variety of sizes is required. Various combinations of vacuum holding, magnet blocks, etc, will be explored to provide a convenient, simple system of print stock holding.

8. Exposure Monitoring and Control

The desirable system to serve this requirement consists of the following steps.

a. Measure the required print exposure by a commercial photoelectric easel photometer [redacted]EP-1000). 25X1

b. Control the exposure by adjustment of lamp voltage and/or of exposure time.

c. Start and end the exposure by turning on and off the printing lamp.

PROGRAM ORGANIZATION

It is proposed that the program to provide a prototype enlarger be scheduled in three phases.

PHASE I - Provide the design concept and specification together with optical designs and the construction and testing of models for certain subassembly designs, such as:

1. Optical design for the objective lens and condenser system for

   a. Narrow spectral band lens (or lenses) for B & W prints, and

   b. Full visible spectrum correction lens (or lenses) for color and for variable contrast B & W prints.

2. The vertical fluid gate suitable for a 70mm square aperture.

3. The negative transport system with X-Y coordinate measuring systems.

4. Possible computer-servo systems suitable for the lens focus position as required by print easel position.

PHASE II - Provide the design engineering and also provide samples made in photo tests of the proposed optical systems.

PHASE III - Complete the fabrication of the prototype enlarger using as many of the components from Phase I and II as possible. Checkout the completed enlarger and report results.